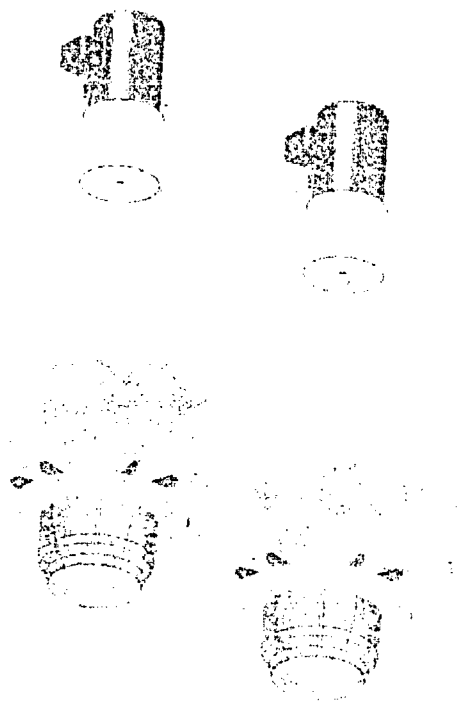
GE Active Containment Sump Strainer for PWR Applications

Licensing Topical Report

NEDC-33162P



November 3, 2004

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Agenda

Objectives and Overview	Stramback/Hamel	15 minutes
LTR Outline	Hayes	30 minutes
Discussion	All	30 minutes
Utility Discussion	Kostelnik (CCNPP)	15 minutes
Conclusion	All	10 minutes

Meeting Objectives

Obtain NRC feedback on:

- Utility implementation under 50.59
- Topics addressed in LTR
- Utility programs
- Proposed Tech Spec changes
- Content of TS License Amendment Request & potential NRC review cycle

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GE 3 Phased Approach

Phase I	Phase II	Phase III
Walkdowns / Analysis / Options Evaluations	Hardware Design and Fabrication	Installation
GE & A/E	GE	GE & A/E

GE Value Added

Scope

Phase I
- Containment walkdown
- Debris generation / transport calculations
- Evaluate feasible resolution options (Passive / Active)

Phase II
- Hydraulic and mechanical design
- Design change package / 50.59
- Hardware delivery
- Project management

Phase III
- Installation
- Project Management
- Strainer Disposal

GE Experience

Phase I
Calvert Cliffs Unit 1
Calvert Cliffs Unit 2 (Pending)
Design W/D at Callaway, Turkey Point, and Kewaunee

Phase II
Calvert Cliffs & Ginna
Ft. Calhoun Proposal
13 BWR Strainer Projects

Phase III
5 BWR Strainer Projects
Calvert Cliffs Proposal

Active Strainer Overview

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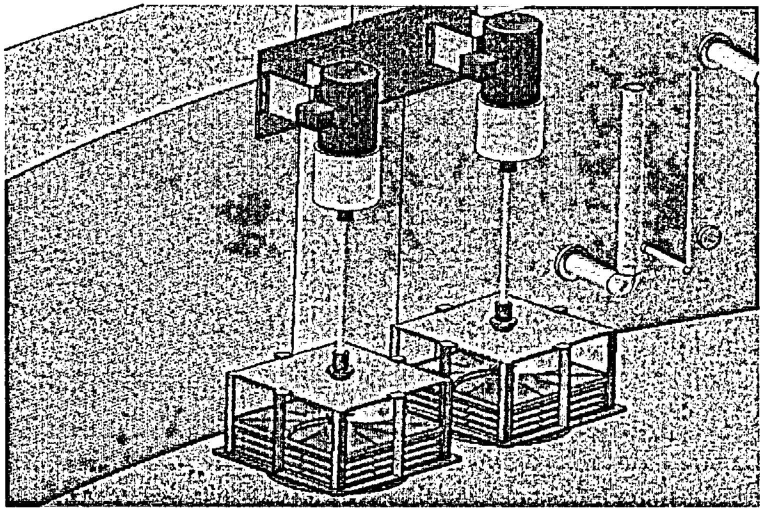
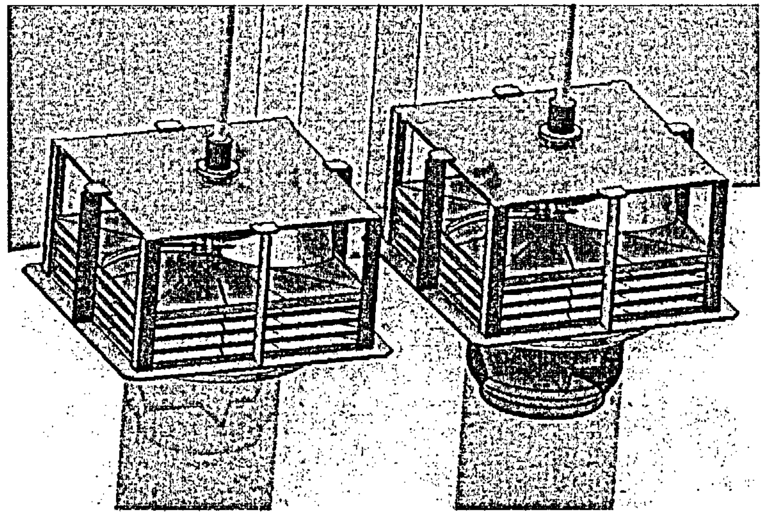
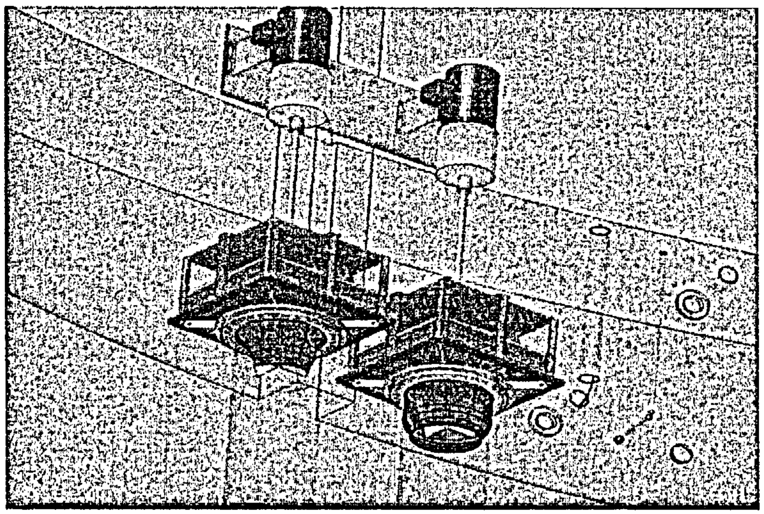
Active Strainer Overview



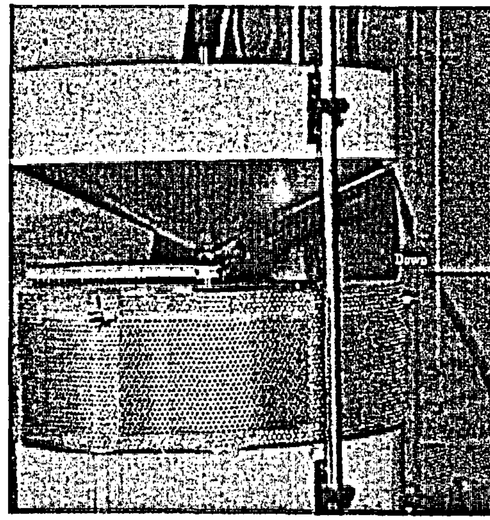




- Headloss independent of debris load
- Most compact / comprehensive solution
- GE patented and patent-pending technology
  - > US Patent# 5,688,402

Active Strainer Overview

- Design based on testing performed during 1995 BWROG Strainer Program – patented design
- Improvement patents pending for refinements on the active design - customized for PWR application
- GE Design Test Program planned for late 2004



12" Prototype Active Strainer Used in Proof of Design Testing Performed in 2003

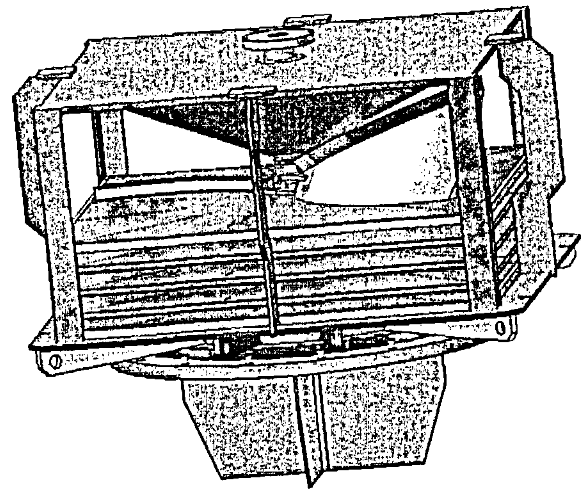
36" Prototype Active Strainer Performed at EPRI During BWROG Test Program in 1995

LTR Outline

1.0 Introduction

Base Documentation:

- NEI 04-07
- GSI-191
- Generic Letter 2004-02
- Draft SE for NEI 04-07



Three Basic Sump Phenomena:

- Debris Generation
- Debris Transport
- Head Loss

GE Active Strainer design resolves GSI-191 regardless of the debris generation and transport

2.0 Hydraulic Design Methodology

Theory of Operation:

Centrifugal forces

Differential densities – fluid vs. debris

Differential velocities – fluid vs. debris

Basic Principles

$$\text{Headloss (ft. of } H_2O) = \frac{1}{2g}\left(\frac{V(ft/s)}{C_v \eta}\right)^2$$

V = fluid approach velocity

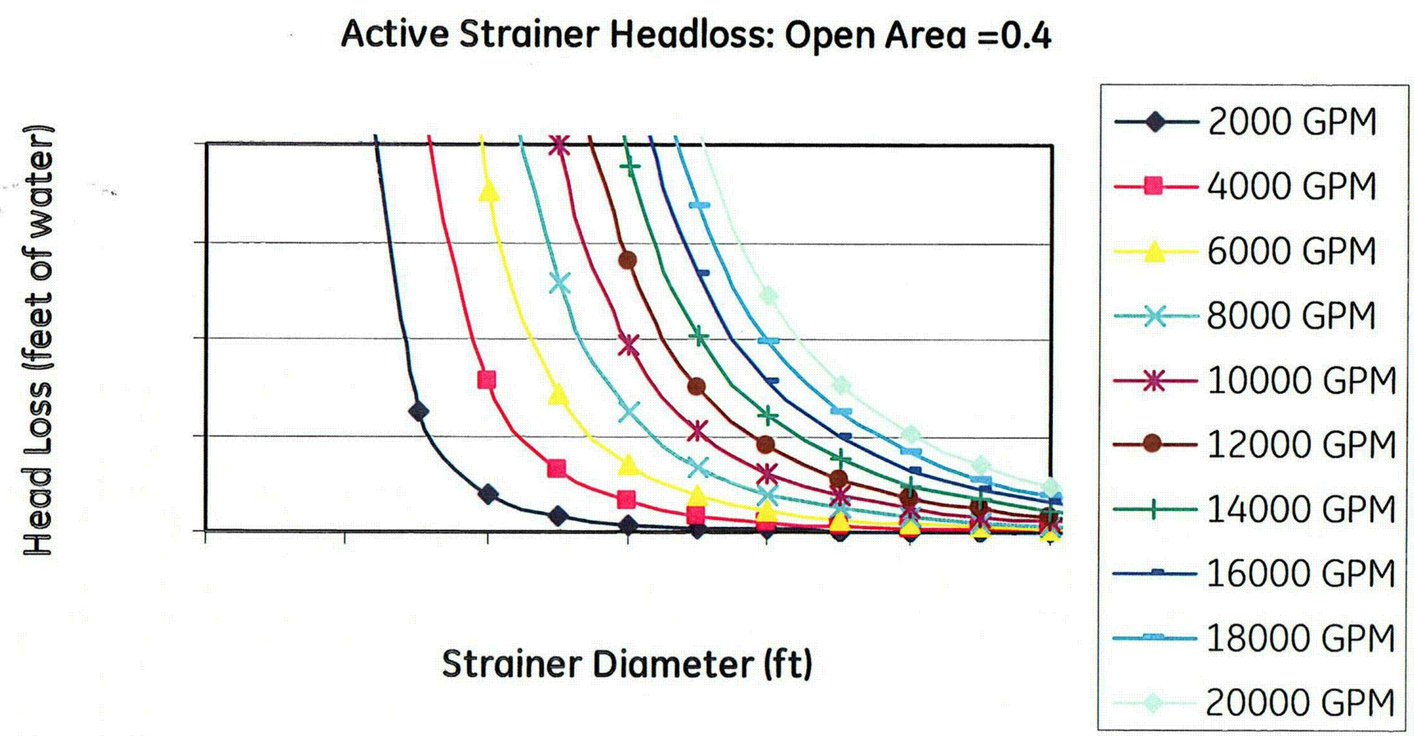
C_v = vena contracta of the flow through the plate

η = ratio of open area to total area of the plate

With a strainer plate that is 40% open and a vena contracta of 0.7, the head loss is less than 1ft, if the approach velocities are kept less than 2ft/s.

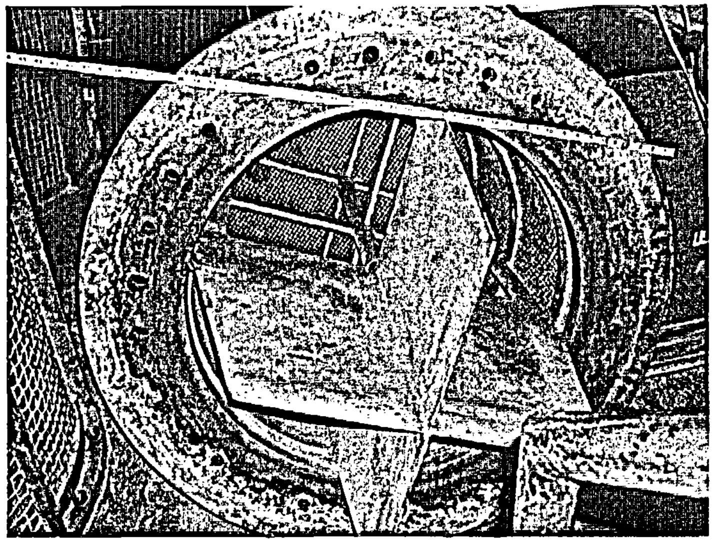
2.0 Hydraulic Design Methodology

Hydraulic design curves are verified by test data



2.0 Hydraulic Design Methodology

- Head loss calculated by classical methods
- Calculations verified against test data
- Testing performed over a range of debris types and concentrations
- Other Considerations
  - –Anti-Vortexing: *addition of vertical plates to eliminate vortexing in sump piping*
  - –Plow Cavitation: *sizing of strainer avoids cavitation*



Vortex Suppression Feature

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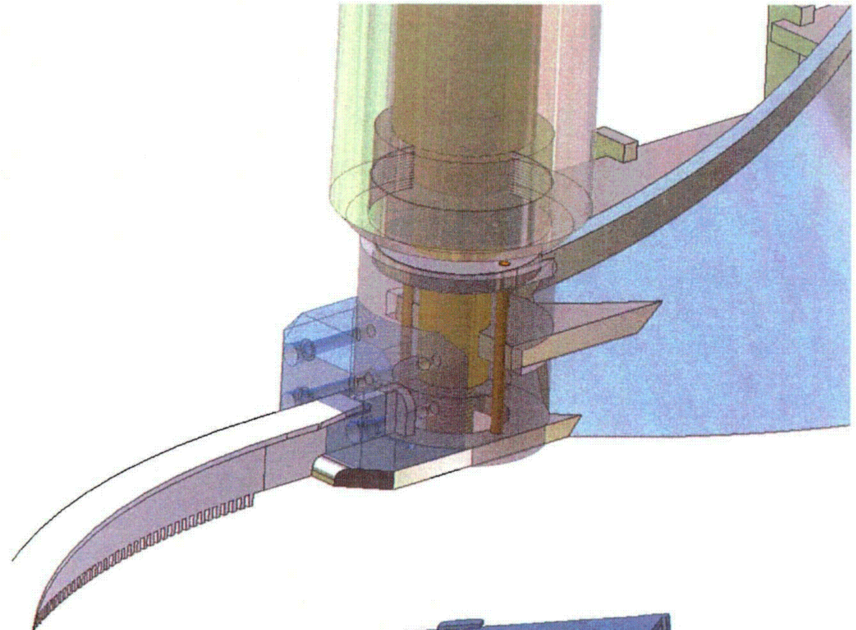
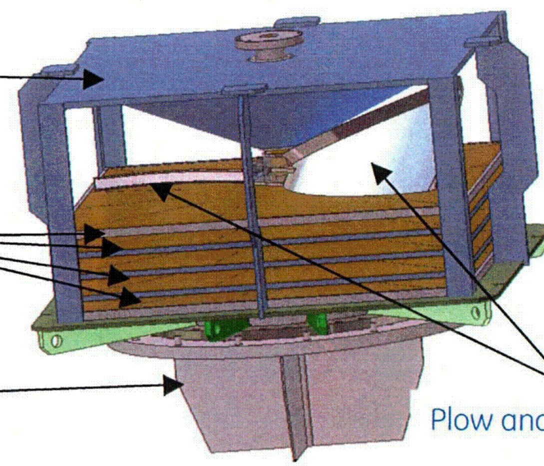
3.0 Description of the Active Strainer

Mechanical Design:

- Plow/Brush/Bearings
- Passive Disks
- Support Structure
- Missile Shield
- Strainer Base
- Vortex Suppressor





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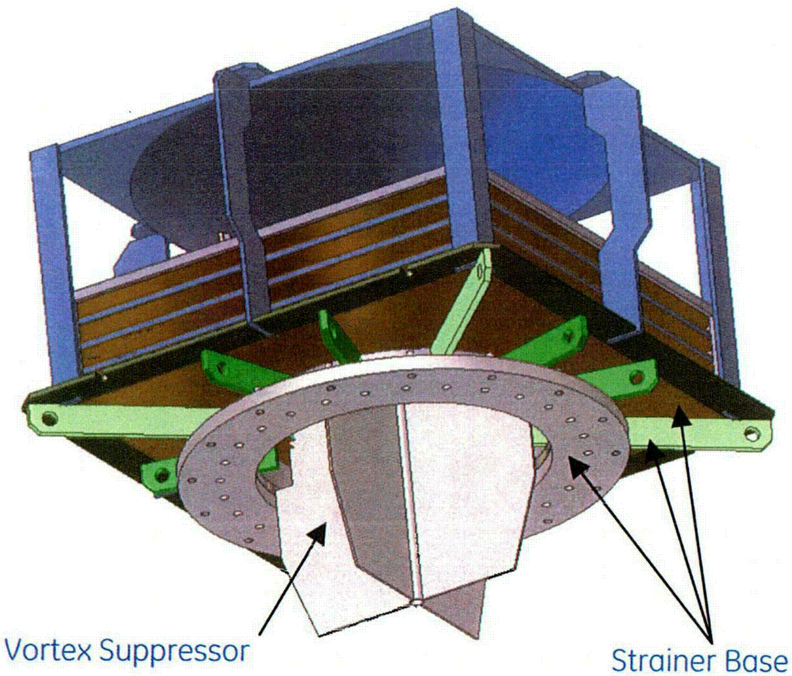
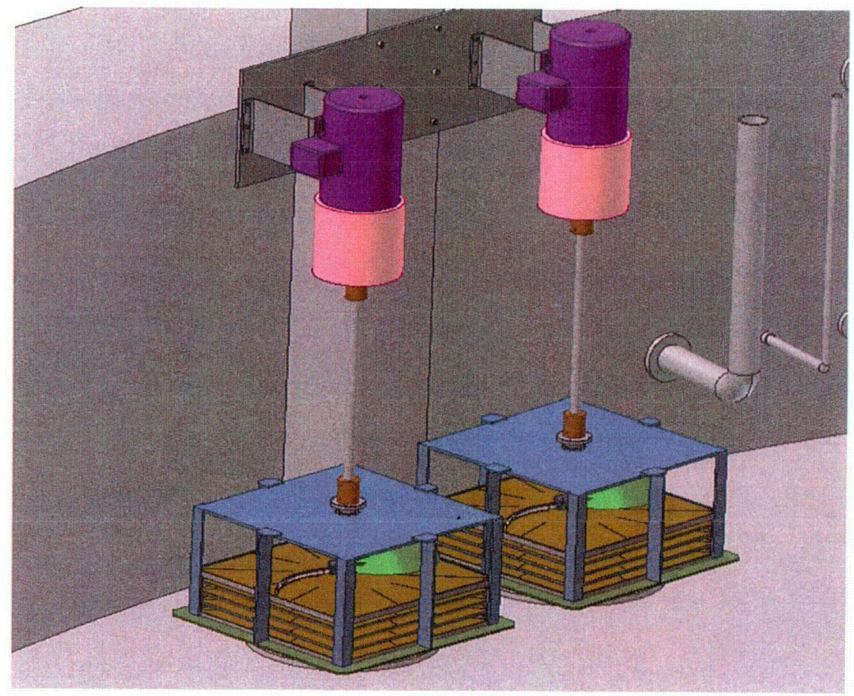
3.0 Description of the Active Strainer

Active Strainer Installation





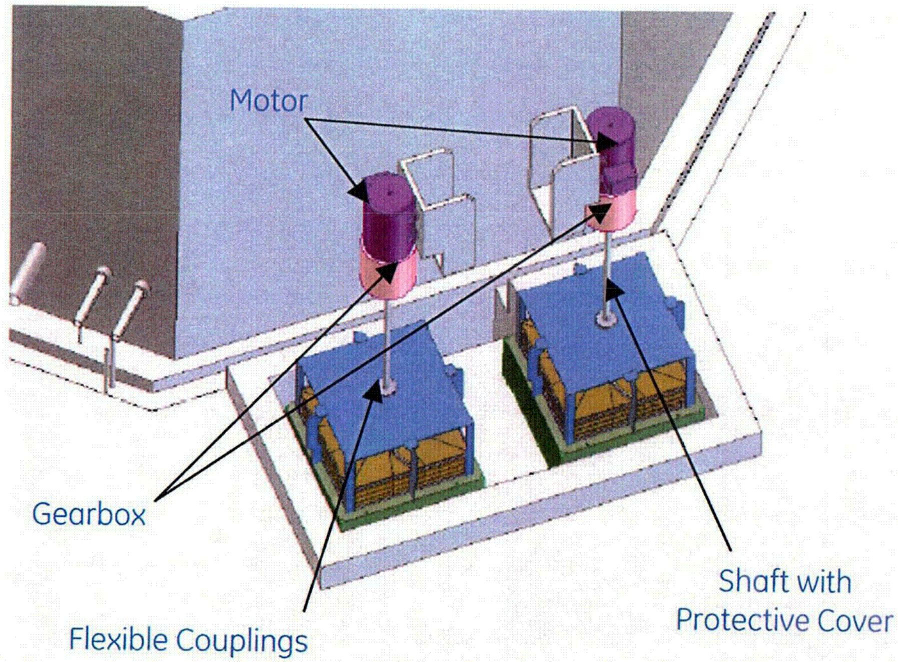
Designed to mount onto existing strainer embedded flanges, minimizing installation time

C03

3.0 Description of the Active Strainer

Strainer Drive System

- Motor – 5-10HP, reversible
- Gear reduction drive – 30:1
- Flexible couplings
- Thrust bearings
- Shaft protection
- Strainer Control and Instrumentation
  - ➢ Differential Pressure
  - ➢ Amperage



Motor and gearbox qualification includes similarity, normal condition aging & accident condition analyses

C04

4.0 Structural Requirements for Plant-Specific Applications

Mechanical Design:

- Seismic analyses
- Hydraulic sizing methodology

Structural Evaluation

- Loads
- Bounding load combinations
- Sump strainer analysis

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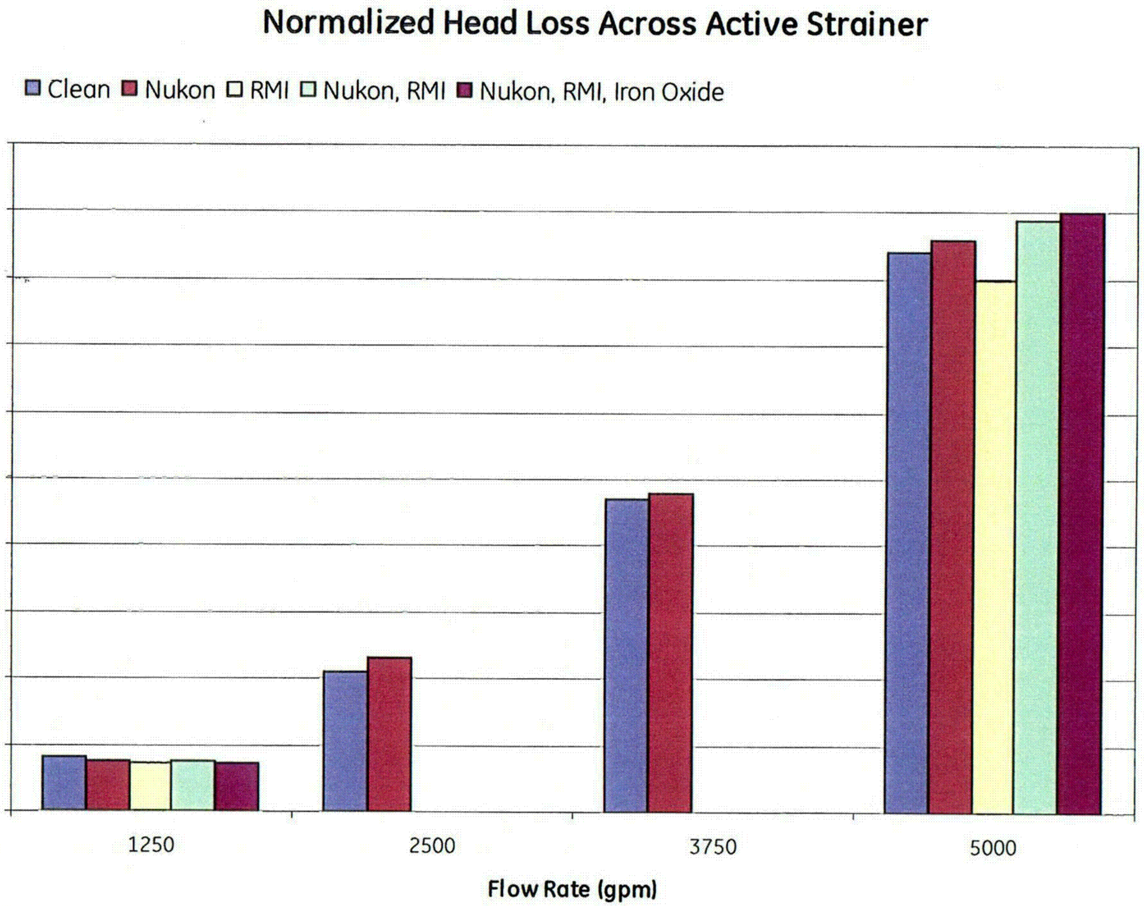
5.0 Testing

Previous testing confirmed that headloss is independent of debris type.



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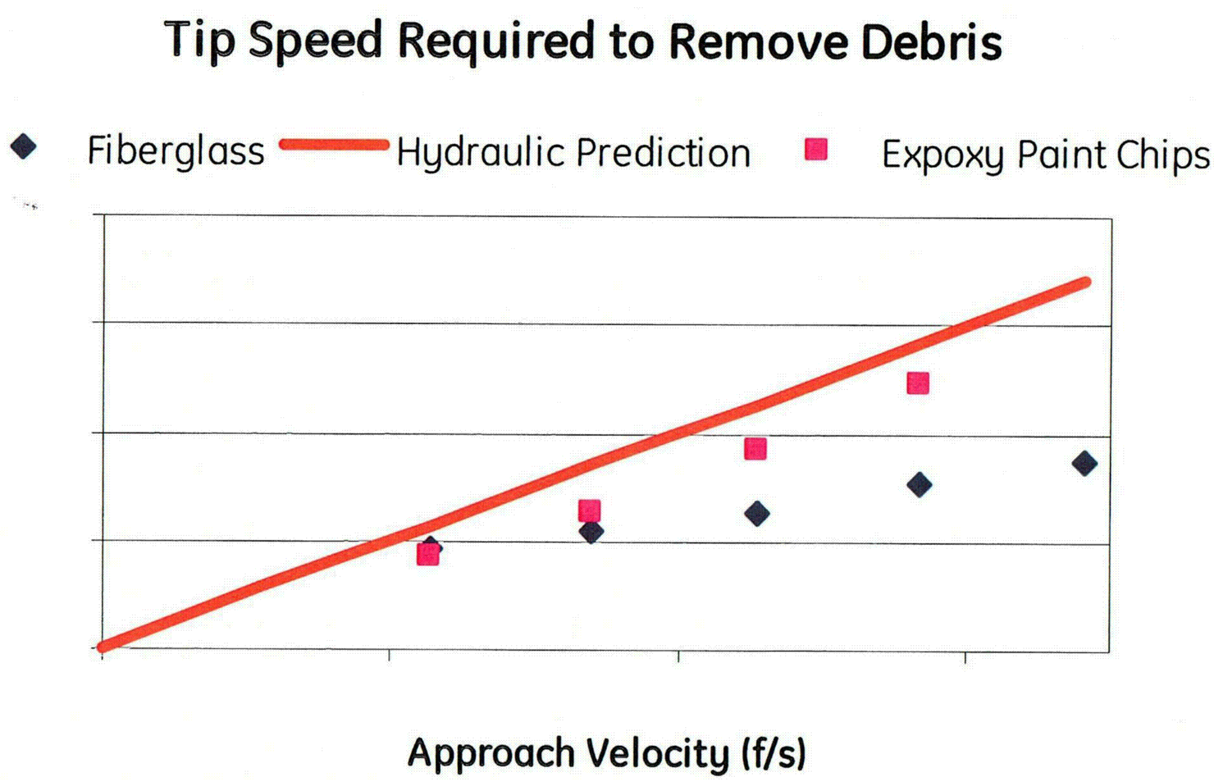
5.0 Testing

Proof of Concept Testing confirmed the hydraulic methodology and predictions



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5.0 Testing

Testing planned for the end of 2004 will cover:

- Overall performance demonstration
- Debris concentration tolerances
- Amount and types of debris bypassed
- Strainer-to-strainer interactions
- Wall effects
- Load definition on the missile shield and perforated plate

6.0 Other Evaluations

- Chemical effects
  - > Need NRC/Industry testing results and guidance to evaluate
- Operator training and human factors
- Plant procedures and modifications

7.0 Licensing Evaluations

- Effect on Technical Specifications
- Environmental Assessment
- Significant Hazards Consideration Assessment

7.0 Licensing Evaluations

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Less than 100% of the ECCS flow equivalent to a single OPERABLE train available.	D.1 Enter LCO 3.0.3.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.2.1	[Verify the following valves are in the listed position with power to the valve operator removed [and key locked in position]. Valve Number / Position / Function [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	12 hours]
SR 3.5.2.2	Verify each ECCS manual, power operated, and automatic valve in the flow path, that is not locked, sealed, or otherwise secured in position, is in the correct position.	31 days
SR 3.5.2.3	[Verify ECCS piping is full of water.	31 days]
SR 3.5.2.4	Verify each ECCS Containment Sump Suction Strainer motor has power available from the Class 1E AC Electrical Power Distribution System.	31 days
SR 3.5.2.~~4~~5	Verify each ECCS pump's developed head at the test flow point is greater than or equal to the required developed head.	In accordance with the Inservice Testing Program
SR 3.5.2.~~5~~6	[Verify each charging pump develops a flow of ≥ [36] gpm at a discharge pressure of ≥ [2200] psig.	In accordance with the Inservice Testing Program

7.0 Licensing Evaluations

ECCS Operating
3.5.2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.2.~~6~~7	Verify each ECCS automatic valve that is not locked, sealed, or otherwise secured in position, in the flow path actuates to the correct position on an actual or simulated actuation signal.	[18] months
SR 3.5.2.~~7~~8	Verify each ECCS pump starts automatically on an actual or simulated actuation signal.	[18] months
SR 3.5.2.9	Verify each ECCS Containment Sump Suction Strainer motor starts automatically on an actual or simulated actuation signal.	[18] months
SR 3.5.2.~~8~~10	Verify each LPSI pump stops on an actual or simulated actuation signal.	[18] months
SR 3.5.2.11~~9~~	[Verify, for each ECCS throttle valve listed below, each position stop is in the correct position. Valve Number [ ] [ ]	[18] months
SR 3.5.2.12~~0~~	Verify, by visual inspection, each ECCS train containment sump suction inlet is not restricted by debris and the suction inlet trash racks and screens show no evidence of structural distress or abnormal corrosion.	[18] months

Discussion

Utility Discussion

Utility Programs

Programs needing NO additional monitoring for an active strainer

- Coatings
- Cleanliness
- Maintenance (beyond the strainer)
- EQ (beyond the strainer)

Conclusion